1. emf = 12 V

$r = 0.4\ \Omega$

$V = IR$

$12 = I \times 0.4$

$I = \frac{12}{0.4}$

$I = \frac{12 \times 10}{4}$

$= 30\ A$

2. emf = 10 V

$r = 3\ \Omega$ (internal resistance)

current in the circuit is 0.5 A

$V = IR$

$10 = 0.5 \times R$

$R = \frac{10}{0.5}$

$R = \frac{10 \times 10}{5}$

$R = 20\ \Omega$

Total $R = (20 - 3)\ \Omega$

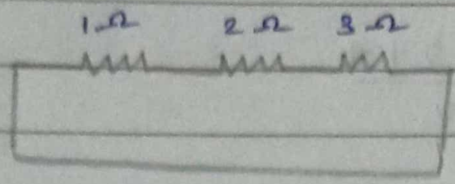
$= 17\ \Omega$

$V = IR$

$=$ ~~17~~ $17 \times \frac{5}{10}$

$= 8.5\ V$

3\. (a) Three resistors 1 Ω, 2 Ω and 3 Ω are combined in series.



(Sol.) Total resistance $(R) = (1 + 2 + 3)\ \Omega$

$= 6\ \Omega$

(b) $V = IR$.

Total $R = 6\ \Omega$

$V = 12\ V$

$V = IR$

$12 = I \times 6$

$I = 2\ A$

Voltage through the resistors:

$V(1) = 1 \times 2$

$= 2V$

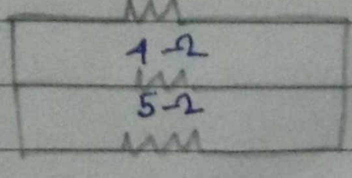
$V(2) = 2 \times 2$

$= 4V$

$V(3) = 2 \times 3$

$= 6V$.

4\. Three resistors 2 Ω, 4 Ω and 5 Ω are combined in parallel.



$\frac{1}{R} = \frac{1}{2} + \frac{1}{4} + \frac{1}{5}$

$= \frac{10+5+4}{20}$

$= \frac{19}{20}$

$= \frac{20}{19}\ \Omega$

(b) $V = I R$

$V = 20\,V$

Total resitance $= \frac{20}{19}\ \Omega$

$20 = I \times \frac{20}{19}$

$I = 20 \times \frac{19}{20}$

$I = 19\ A$

$V(2) = 19 \times 2$

$= 38\ V$

$V(4) = 19 \times 4$

$= 76$

$V(5) = 19 \times 5$

$= 95$

$V = I R$

$38 = I \times \frac{20}{19}$

$I = 38 \times \frac{19}{20}$

current for 2 Ω resistor

$V = I R$

$20 = I \times 2$

$I = \frac{20}{2}$

$I = 10 A$

current for 4 Ω resistor

$V = I R$

$20 = I \times 4$

$I = 5 A$

Current for 5 Ω resistor

$V = I R$

$20 = I \times 5$

$I = 4 A.$

5. Resistance $= 100\,\Omega$

temp $= 27.0°C$

$R_t = 117°C$

$a = 1.70 \times 10^{-4} / °C$

$$a = \frac{R_1 - R_{27}}{R_{27}(t-27)}$$

$$t - 27 = \frac{17}{100 \times 1.70 \times 10^{-4}}$$

$t = 1000 + 27$

$= 1027°C$

6. $L = 15\,m$

$A = 6.0 \times 10^{-7}\,m^2$

$R = 5.0\,\Omega$

$$R = P\frac{AL}{A}$$

$$P = \frac{RA}{L}$$

$$= \frac{5 \times 6.0 \times 10^{-7}}{15}$$

$= 2 \times 10^{-7}\,\Omega\,m$

7. $R_{27.5} = 2.1\Omega$

$R_{100} = 2.7\Omega$

$$a = \frac{R_{100} - R_{27.5}}{R_{27.5}(100 - 27.5)}$$

$$= \frac{2.7 - 2.1}{2.1(72.5)}$$

$$= \frac{0.6}{2.1(72.5)}$$

$$= 0.0039 /°C$$

8. Potential difference $= 230V$

$I_{27°C} = 3.2 A$

$I_{t°C} = 2.8 A$

Room temp. $= 27°C$

$a = 1.70 \times 10^{-4} /°C$

$$R = \frac{V}{I}$$

$R_{27°C} = \frac{2300}{32}\Omega$ $R_{t°C} = \frac{2300}{28}\Omega$

$a = 1.70 \times 10^{-4} \, °/C$

$$a = \frac{\frac{2300}{28} - \frac{2300}{32}}{\frac{2300}{32}(t - 27)}$$

$$1.70 \times 10^{-4} = \frac{82.143 - 71.875}{71.875 \, (t - 27)}$$

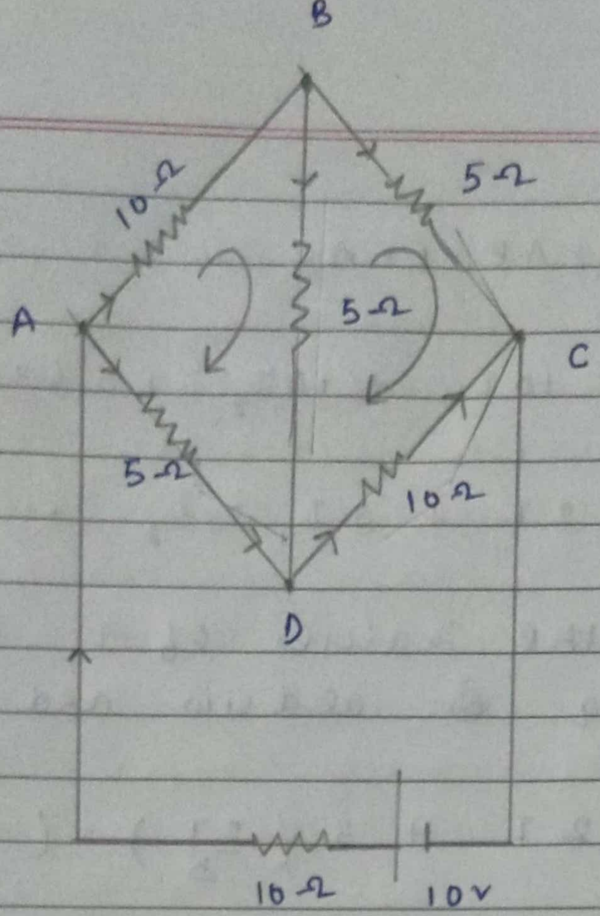
$$t - 27 = \frac{82.143 - 71.875}{71.875 \, (1.70 \times 10^{-4})}$$

$$t - 27 = 840.347$$

$$t = 840.3 + 27$$

$$t = 867.3 °C$$

9.



In loop ABDA

$$10 I_1 + 5I_2 - 5(I - I_1) = 0$$

$$2 I_1 + I_2 - I - I_1 = 0$$

~~$3I_2$~~ $3 I_1 + I_2 = I \quad \ldots (i)$

In loop BCDB

$$5(I_1 - I_2) - 10(I - I_1 + I_2) - 5I_2 = 0$$

$$5 I_1 - 5 I_2 - 10 I + 10 I_1 - 10 I_2 - 5 I_2 = 0$$

$$3 I_1 - 4 I_2 = 2 I \quad \ldots (ii)$$

$$I_1 = \frac{2I}{5} \qquad I_2 = -\frac{I}{5} \quad \ldots (iii)$$

In loop ABCEFA

$10 = 10I + 10I_2 + 5(I_1 - I_2)$

$2 = 2I + 3I_1 - I_2$ ... (iv)

Putting the values of I_1 and I_2 from eq. (iii) and (iv)

$2 = 2I + 3\left(\frac{2I}{5}\right) - \left(-\frac{I}{5}\right)$

$2 = \frac{17}{5} I$

$I = \frac{10}{17} A$

Current in branch AB,

$I_1 = \frac{2}{5} \times \frac{10}{7}$

$= \frac{4}{17} A$

$I_2 = -\frac{1}{5}$

$= -\frac{2}{17} A$

Current in branch AB is $I_1 = \frac{4}{17} A$

Current in branch BC is $I_1 - I_2$

$= \frac{4}{17} + \frac{2}{16} = \frac{6}{17} A$

Current in branch AD is $I - I_1$

$= \frac{10}{17} - \frac{4}{17}$

$= \frac{6}{17}$ A

Current in branch DC is $(I - I_1) + I_2$

$= \frac{6}{17} - \frac{2}{17}$

$= \frac{4}{17}$ A.

10.

(a) $l = 39.5$ cm

~~R = 12.5 Ω~~

$\text{Resistance}_Y = 12.5$

$\text{Resistance}_X = ?$

$\frac{X}{Y} = \frac{l}{100 - l}$

$X = \frac{l}{100-l} \times Y$

$= \frac{39.5 \times 12.5}{100 - 39.5}$

$= 8.16\ \Omega$

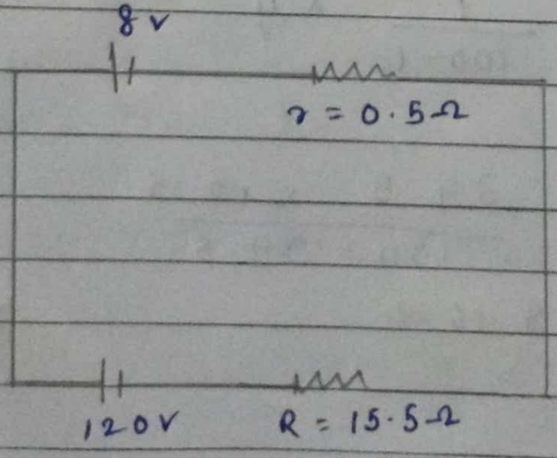
In meter bridge, the resistance at the connections is not taken in the consideration that's why the connections between resistors in a wheatstone bridge or meter bridge made of thick copper stripes because more is the thickness lesser be the resistance so due to thick copper stripes, the resistance at the connections becomes minimum.

(b) If X and Y are interchanged, then the balance length will also be interchanged. Thus, the balance becomes

$100 - 39.5 = 60.5$ cm

(c) If the galvanometer and cell are interchanged at the balance point of the bridge, the balanced point is not obtained. The galvanometer shows no deflection.

11.



Emf of the battery = 8 v
emf of DC supply v = 120 v

Since, the battery is bring changed, so effective emf in the circuit

$E = v - e$
$= 120 - 8$
$= 112 \text{ v}$

Current in circuit

$I = \frac{E}{R + r}$

$I = \frac{112}{0.5 + 15.5}$

$I = \frac{112}{16}$
$= 7 \text{ A}$

The battery of 8 v is being charged by 120 v, so the terminal potential across battery of 8 v will be greater than its emf

Terminal potential difference $V = E + Ir$
$= 8 + 7(0.5)$
$= 11.5 \text{ V}$

The purpose of the series resistor is to control the current drawn from the external supply, other the current in the circuit will be very high.

12. $E_1 = 1.25\ V$

$l_1 = 35\ cm$

$l_2 = 63\ cm$

$$\frac{E_1}{E_2} = \frac{l_1}{l_2}$$

$$\frac{1.25}{E_2} = \frac{35}{63}$$

$$\frac{1.25 \times 63}{35} = E_2$$

$E_2 = 2.25\ V$

13. $n = 8.5 \times 10^{28} / m^3$

$l = 3\ m$

$I = 3\ A$

$e = 1.67 \times 10^{-19}\ C$

$$t = \frac{I}{v_d}$$

$I = neAv_d$

$v_d = \frac{I}{neA}$

$t = \frac{LneA}{I}$

$= \frac{3 \times 8.5 \times 10^{28} \times 1.6 \times 10^{-19} \times 2 \times 10^{-6}}{3}$

$t = 2.72 \times 10^{4}\ s.$